Earth & Environmental Sciences Division

News, Views & EEScience

Disclaimer: this monthly update is intended for internal distribution within the Earth and Environmental Sciences Division at Los Alamos National Laboratory and must not be distributed outside of LANL.

Safety

A Message from Jeff

Jeff Hansen, Division ES&H Officer, 667-5043, jchansen@lanl.gov

Unlisted Electrical Safety Issues

Effective on October 1, 2003, all Los Alamos personnel or contractors are requested to use or purchase electrical devices that are "listed" and carry a mark from a Nationally Recognized Testing Laboratory (NRTL) or have been tagged by a Los Alamos Electrical Safety Officer. If you have equipment now in your possession that is not carrying a UL® label or a certification from an EES Electrical Safety Officer, please do not use it until we can look it over.

You may have noticed several recent articles in the Los Alamos News Bulletin Readers' Forum about the labeling of electrical equipment for safety. There are several labels that are acceptable within the electrical safety LIR, not limited to UL®, although this one is seen the most often.

The EES Division's group and division electrical safety officers have recently completed an inspection and tagging program of the division looking for NRTL listed equipment. We located approximately 3,000 pieces of electrical equipment.

While we found that most of our equipment is properly listed, typically with a UL® label, we did find a few that had no certification. Some of this equipment apparently was brought here from home.

At least for now, a division's certification is not automatically acceptable to another division. Those who find themselves at the Test Site will find that DX does not automatically accept EES Division certifications. This will probably be true for RRES, HSR, and any other divisions we may work with.

Some scientific equipment is not NRTL tested or listed, yet we still require it to do our job. In this case, a group or division Electrical Safety Officer will have to inspect it for approval. If it is found to be unacceptable, it cannot be used here. This is particularly true for local Laboratory built or modified equipment. Contact Jeff Hansen, 7-5043 or Gary Luedemann, 7-7674 for details if you need a certification.

Security

An Ear on the LIR from Tony

Tony Montoya, Acting Division Security Officer (DSO), 7-8065, antonio@lanl.gov

Virus Alert & Networks

As you know, there is a virus war going on. On September 11, we pushed out an anitviral update for Windows-based machines. We have asked people not to connect their laptops (if they were not already on the network) until the latest security patch is applied.

We now have 3 networks that could be made available if desired. There is the good old yellow network that you use everyday. There is the visitors' network that is for visitors who

only want to check the internet and their e-mail. Also, there is a collaborator network.

All of these networks require paper work for access and documentation from the System Administrator. We are here to help you.

Organizational News

EES-2 Acting Leaders

Prompted by the retirement of Fairley Barnes this month, **Jim Bossert** has agreed to serve as Acting Group Leader for EES-2. As the current Deputy Group Leader for EES-2, Jim is intimately familiar with the daily operations of the group. Jim has appointed **Mike Ebinger** as the EES-2 Acting Deputy Group Leader and will soon name someone to serve as the Acting Deputy Group Leader while Mike is on vacation.

Jim will serve until the completion of the ongoing search for a permanent Group Leader is completed.

New EES-7 Group Leader

It gives me great pleasure to announce the hire of **Dr. Ken Rehfeldt** as the new Group Leader of EES -7. Ken is a geoscientist with a very broad background and has extensive experience with the Underground Testing Area project at Nevada Test Site (NTS). Ken has served as the technical lead for GeoTrans Inc. program to assess the ground water transport of radioactive contamination from underground testing and has worked closely with Los Alamos and NNSA scientists on a number of environmental management projects at NTS.

Dr. Rehfeldt has a B.A.. degree in Geologic Sciences from the University of Wisconsin, a M.S. in hydrology from New Mexico Tech, and a Ph.D. in Civil Engineering from Massachusetts Institute of Technology. Before coming to Nevada to work for GeoTrans, Ken was the Director of the Office of Ground Water Quality in Illinois. Ken's technical speciality is hydrogeology and he has extensive experience both in modeling and measurement. He has an extensive publication record, and is an excellent communicator both to technical and lay audiences.

Ken's start date is September 29, and he will be in Los Alamos September 29 through October 1. I encourage you to meet with Ken when he is here, and welcome him to EES division.

Annual Performance Evaluations, Salary Management, and Raises

- A Rock Solid Message from Terry Wallace

Annual Performance evaluations are extremely stressful for everyone involved. There is a perception that an employee's hard work of an entire year is reduced to a single numerical score, which in turn, translates to a raise for the new fiscal year. Many employees make the assumption that the size of their raise is the final measure of personal worth to the institution. Unfortunately, distillation of the entire evaluation to an ORC score and raise often results in a negative response, and makes the annual review feel almost punitive. In fact, these perceptions are not the purpose of the annual review. Below I will give you my thoughts and perceptions of a process that is composed of a set of very disparate functions.

The annual review has five specific components. These are: 1) the line managers written

review of annual accomplishment, 2) the assignment of numerical scores for job content and job performance, 3) normalization of the numerical scores within a peer group, 4) face-to-face meeting(s) between employee and line manager to discuss the evaluation, and 5) salary management. Each of these steps has a specific objective and should be considered individually:

(a) **Written Review of Accomplishment**. This is the single most important part of the annual review, and provides the opportunity for both recognition of outstanding accomplishment and advice for further employee development. The scientists and staff in EES are, in general, outstanding and very high achievers. This generally means that an individual's expectations for their performance are also very high, which is a double-edged sword. On the one hand, nearly every employee is used to being among the "best of class", yet managers need to also use the review as a venue for suggesting improvement. The identification of ways to improve is sometimes perceived as criticism, which reduces the written evaluation to punitive declaration. This is never the purpose of the evaluation; the evaluation is designed to be a chronicle of accomplishment! The suggestions for improvement are the responsibility of every line manager and should be viewed as a constructive path forward.

(b) **Job Content and Job Performance Scores**. Although the written evaluation is the most important part of the annual review, there is a need for quantification of an individual's accomplishments. Every employee has different job portfolios and the only way to appreciate this is to divide the performance metric into two parts. These scores reflect the fact that employees with the same job title have very different responsibilities and thus different job content scores. Likewise, a person's performance is individual but their performance can and should be ranked relative to their peers.

(c) **Normalization of the Overall Relative Contribution Scores** (ORC) (rolling up to a peer group). Every line manager has their own methodology for assigning ORC scores. If there were a single evaluator for the entire division, then the methodology would be uniform. However, peer groups combine employees from across the division, and thus, mix methodologies. The normalization of the scores within a defined peer group requires active engagement by line managers to define the scores from a division wide perspective. In my experience, the line managers do try to think in terms of the entire division but are still advocates for their employees. The real "problem" at the end of this process is that while the ORC scores solely reflect relative job content and performance, there is an overwhelming desire to translate this metric to an academic style grade. Over and over I have heard that ORC scores of 9 and above are equivalent to an "A"; scores between 8 and 9 translate to a "B", and so on. This is completely false, and removes the whole concept of relative from the ORCs. An example, I would like to share with you: my ORC scores from ADSR: I received a 3.5 in both content and performance for a total score of 7.0. **However, I realize that this score is a relative ranking, and look to the written evaluation for guidance in my assessment** – I certainly don't think that I got a D+ or C- in my job and neither does my supervisor!

(d) **Face-to-Face Management and Employee meeting(s)**. The final part of the review process is a meeting between the appropriate line manager and the employee. This meeting should also begin the process to define expectations and challenges for the future.

(e) **Salary Management**. Although the annual evaluation process can stand alone as a measurement of the overall contribution of an employee to the institution, it is also useful for salary management. Every year DOE provides guidance for new salary increase allocation

(called the SIA) that should account for cost-of-living changes and issues like promotions. There is a view that the salary adjustment is distributed purely on the basis of yearly performance as codified by the ORC score. In actuality, the process is much more complicated and is closely related to systemizing pay versus performance within a peer group. Since individual salary is a historical assessment of performance and job title, the ORC score in any given year may not be correlated with ones current salary. Line managers use the SAI moneys to make the pay scales within a peer group rational. This can result in some odd appearing allocations. For example, the highest ORC score this year could correspond to an employee that has a much higher salary than anyone else in the peer group. The high historical salary could, therefore, preclude any incremental raise if the remainder of the peer group is viewed as underpaid. **For this reason, the salary adjustment is known as "salary management".**

The complex process of annual evaluation and salary management requires a holistic view. It is not possible to reduce an evaluation to salary increment or ORC scores. This year in EES the entire process took more than a month, and a "good" part of a review is sometimes lost in the sense that it is competition. I am really amazed by and impressed with all the excellent work that is going on in the division, and I am heartened by the written evaluations that our group and team leaders produced.

Dollar$ and $ense New$

The EES division closed the books on FY 03. It was a good year for the division with more than a dozen projects with a combined budget of 66 million dollars. **The division overhead accounts finished with a deficit of 18.7 thousand dollars – or within .3 percent of the Division and Groups overhead accounts!** This is a fantastic accomplishment considering the complexity of our operations, and many people deserve credit for this budgeting acumen – Geri Lujan and her Business Team deserve huge THANKS! In these times of scrutiny of Los Alamos and the looming competition for the UC contract, it is worthwhile to consider the successes of our business practices. For example, the present deficit of the USA is projected to be 400 billion dollars this year, or 3 percent of the total national economy!

Service Anniversaries & Congratulations to the Following

Jeff Heikoop, **EES-6, 5 years**

Leigh House, **EES-11, 20 years**

Joe Leo Martinez, **EES-2, 30years**

Congratulations to

Thom Rahn and Julianna Fessenden-Rhan-Adam Rahn was born on September 15. He weighed in at 7 pounds, 7 ounces.

News from the Science and Engineering Leadership Team

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In September, SELT discussed the capabilities in our division with Acting Division Leader

Terry Wallace. Terry presented his impressions from the Division Retreat in detail and his emphasis on strategic planning. Division management can foster long-term programs and position the division for future growth. SELT and the Division Office are in agreement that the entire division must be involved in strategic planning and that the retreat was just the first step in this process. Terry also informed the SELT of the upcoming IPD/G&A reinvestment program. This helped spawn several proposals to be forwarded by Terry.

The SELT is still pursuing the issue of off-site representation for EES-7 and EES-12 in the SELT. With help from the Division Office, the SELT hopes to encourage participation by both off-site groups via teleconferencing during our regular Monday afternoon meetings. Terry is very supportive of our efforts to include these two groups, which are a significant portion of our Division.

Wendee Brunish, the EES Division representative on the LDRD-ER council, briefed the SELT on the results of this year's LDRD-ER proposals. EES was well represented in the subcategory teams; however, there was some discussion about the process within the Laboratory. SELT agreed that there needed to be more standardization or transparency in the process. We will provide feedback to Howard Hanson, STB.

Finally, the SELT agreed there should be the position of Vice Chair for the SELT to serve as chair when needed and succeed the current chair when his/her term is up. A unanimous vote elected Paul Rich to be the new vice chair. Welcome to Paul in his new role.

Upcoming SELT Sponsored Events:

October 6 – Paul Weber will discuss his new position in ADTR and Defense Transformation.

October 20 (tentative) – Gary Geernaert, IGPP, *has been invited to discuss funding structure, and the E&E Council and how EES might become more closely aligned with their Mission.*

Research Quarterly Recognizes WoldeGabriel

The Summer 2003 issue of the Los Alamos Research Quarterly features Giday WoldeGabriel's (EES-6) research, "New Human Subspecies Announced." Read more about the Middle Awash Research Group's discoveries of fossils and H. sapiens idaltu in the Afar region of northeastern Ethiopia.

Fossil of *H. sapiens idaltu*, housed in the National Museum of Ethiopia, Addis Ababa. Photo © 2001 David L. Brill/Brill Atlanta

http://www.lanl.gov/quarterly/
http://wwwlanl.gov/quarterly/dateline.shtml

Weekly Highlights / Accomplishments sent to ADSR

Defense Advanced Research Projects Agency and Bechtel Corp. Tour Yucca Mountain

Bruce Reinert of the Earth and Environmental Sciences Division's Yucca Mountain Project (YMP) provided an underground tour for representatives of the Defense Advanced Research Projects Agency (DARPA) on August 25-26. Participants in the tour from DARPA/University of Michigan were: John Saunders, Research Assistant; Martin Buehler, Associate Professor; Donald Campbell, Research Assistant; and Dan Koditschek.
Leo Christodoulou, Alan Rudolph, and Robert Cartledge attended the tour and represented DARPA. John Blitch, Blitch Solutions was also a participant in this tour. The group's tour included the testing of a small robot that involved maneuvering it in an underground environment.

Jim Cameron from Bechtel Corporation visited YMP on August 28; Jim is investigating the possibility of using the existing excavated rock from the Exploratory Studies Facility and the rocks to be excavated from the emplacement drifts as invert material.

Frontiers in Science Public Lectures Features Groundwaters of Northern New Mexico

This fall, The Frontiers in Science Public Lecture Series will feature Dr. Elizabeth Keating of Los Alamos' Earth and Environmental Sciences Division. Dr. Keating will discuss the search for water closer to home by describing her research, which focuses on three-dimensional computer models of groundwater flow to interpret various hydrogeologic data and to suggest possible future scenarios for local groundwater basins.

Groundwater aquifers in Northern New Mexico store a vast amount of fresh water, supplying the majority of the water we drink. The combined impacts of drought and expanding populations in the region, however, are causing aquifer water levels to decline and wells to run dry. Answers to such questions as, "how fast are we depleting the groundwater resource?" and, "how much fresh water is left?" require careful research in the hydrogeology of the aquifers. Hydrogeology blends two earth sciences, hydrology and geology, to understand how water flows in aquifer rocks, to explain historical trends in flow, and to predict future trends in water quantity and quality. Our research focuses on the Española Basin and uses three-dimensional mathematical computer models of groundwater flow to interpret these various hydrogeologic data and to suggest possible future scenarios for local groundwater basins. This research is one important component of our collective effort to protect this precious resource.

The Frontiers in Science Public Lecture Series is in an effort to inform the neighboring communities about the broad range of scientific and engineering research that is being done at Los Alamos National Laboratory. The series will highlight Laboratory science and will be presented by Laboratory scientists. The detailed program is available at http://stb.lanl.gov/program/frontiers.shtml.

Earth and Environmental Sciences Receives Two Distinguished Performance Awards

Tropical Western Pacific ARM Team

The staff of the Tropical Western Pacific (TWP) Project has been awarded a Large Team Distinguished Performance Award. This team is part of the United States Department of Energy's (DOE) Atmospheric Radiation Measurement (ARM) Program, a national program of great importance to understanding and predicting global climate. The ARM pro-

gram is central to the US Climate change research program portfolio, and thus, the TWP team is an integral part of DOE's effort to address a major political and technical problem that has large impacts at the national and international levels, bringing distinction to Los Alamos National Laboratory. The overall goal of the DOE ARM Program is to improve the predictive capabilities of General Circulation Models (GCMs) by improving the treatment of radiative transfer and the parameterization of cloud properties and cloud formation used in those GCMs. The central infrastructure of the ARM program depends on implementation and operation of three permanent climate-monitoring stations to supply long-term continuous and high quality data to support the model developments. One of these sites, the Tropical Western Pacific is directed out of the TWP Project Office at Los Alamos National Laboratory. Since 1992, the TWP team has developed and operated Atmospheric Radiation and Cloud Stations (ARCS) in remote locations in Papua New Guinea (PNG) and the Republic of Nauru. Recently, Los Alamos' TWP team led an international collaboration of scientists and technicians in installing a third ARCS in Darwin, Australia that began collecting data on April 1, 2002. The management plan had significant risks. The contracting process, the site approval, and the construction of the new maintenance center all needed to stay on schedule to ensure success of the TWP program at PNG and Nauru as well as Darwin.

The Distinguished Performance Award for the ARM Tropical Western Pacific team recognizes the team's direct and significant contribution to the success of the DOE climate change research program. The team has truly excelled in their performance of the broad spectrum of scientific, engineering, technical, administrative, and management activities needed to achieve ambitious near-term goals while maintaining their operational objectives and reducing overall costs. **The TWP team is an excellent example of what a highly diverse and dedicated team, from widely ranging backgrounds can accomplish when motivated by a clear goal of improving the understanding of the world we live in.**

For more information about the TWP operations @ www.twppo.lanl.gov.

Sandoval and Whitaker Contribute to WATUSI

Thomas Sandoval and Rodney Whitaker, Earth and Environmental Sciences Division's Atmospheric, Climate, and Environmental Dynamics Group, were recently notified that their participation in the WATUSI Experiment Team recognized them as recipients of a Large Team Award for a Distinguished Performance Award. The team consisted of representatives from many Los Alamos Divisions, Sandia National Laboratory, organizations representing the Nevada Test Site, and DOE/NNSA-NV.

Watusi was high explosive test at the Nevada Test Site that was observed by seismic networks and infrasound stations. Sandoval and Whitaker's part was to record the event from infrasound arrays at distances of about 50 km to 890 km from the test. All of our stations recorded signals from the test, which had a size of 19 tons. These new data fit well with our data from earlier tests taken from 1982 to 1992.

The Laboratory's Watusi Experiment Team's goal was to demonstrate that US national security depends on our ability to accurately detect and verify seismic and infrasound events (ground based monitoring). The purpose of ground based monitoring of nuclear explosions, places an emphasis on our need to distinguish between naturally occurring and man-made events. This experiment, conducted at the Nevada Test Site, involved a

38,000-lb explosive shot (TNT equivalent) that was used to characterize new infrasound sensors, including a novel superconducting sensor, and to compare new sensor performance with existing infrasound and seismic diagnostics for detection of low-end seismic events and nuclear tests. The successful conduct of the Watusi experiment demonstrated a characteristic that is more essential than ever for our Nation-that of cooperation and partnership amongst multiple agencies to carry out a large, complex and hazardous task in a timely, and cost-effective manner. Thanks to the Watusi Team, the Laboratory was successful in planning, leading, and executing this extraordinary endeavor under a very short deadline. The level of work performed on this project is a demonstration of the highest standards of science and engineering at the Laboratory.

The Watusi Team has brought Laboratory credit and visibility to DOE, NNSA and other governmental agencies. **The successful completion of this experiment positions the U.S. and the NTS favorably, should nuclear testing need to be resumed.** In addition, the reputation of the Laboratory was significantly enhanced within the Intelligence Community by the successful completion of this experiment.

AARP Tours Yucca Mountain

Bruce Reinert of the Earth and Environmental Sciences Division's Yucca Mountain Project conducted a tour for a group of 45 individuals from the American Association of Retired Persons (AARP) on September 3. The group's tour consisted of a general briefing of the tunnel layout and experiments (both completed and ongoing). This occurs underground in an excavation off the main tunnel called an "Alcove". This Alcove has been customized for tours, including maps/displays and is about 160 meters (200 yards) underground.

Environmental Damage from Hydrogen Fuel Cells Questioned

A press release by the Associated Press on September 8 about studies on the effects of atmospheric hydrogen features Dr. Thom Rahn, a scientist in the Earth and Environmental Sciences Division. The article states, "Los Alamos researcher Thom Rahn headed a team of scientists from California universities and the National Center for Atmospheric Research in Boulder, Colo. Their study of the natural cycle of atmospheric hydrogen was published in a recent edition of the British science journal Nature. The study indicates that hydrogen fuel cells may not be the most environmentally friendly answer to America's dependence on foreign oil. Rahn and other Los Alamos researchers are studying how the atmosphere might respond to increased hydrogen and are establishing a baseline for further comparisons." For more information, see

http://www.newsday.com/news/science/wire/sns-ap-hydrogen-study,0,6877119.story?coll=sns-ap-science-headlines

Yucca Mountain Tours County Officials, Energy, and Environmental Communities

Bruce Reinert, of the Earth and Environmental Sciences Division's Yucca Mountain Project, conducted tours on September 10 for a group of 26 from De Vry University, Environmental Science, and John Loy, Chief Executive Officer for the Australian Radioactive Protection and Nuclear Safety Agency. A tour was conducted on September 11 for representatives from the Energy Communities Alliance, Protage Environmental, Los Alamos County, Wells Fargo Bank, City Council of Arvada, Colorado, Hanford Communities, the Mayor of Benton County, City Council of Richland, Washington, and the City Manager of Oak Ridge, Tennessee.

Los Alamos, New Mexico Tech, and Sandia Participate in University of Wisconsin Workshop

Professor Cliff Thurber from the Department of Geology and Geophysics, University of Wisconsin (UW) hosted participants from Los Alamos National Laboratory, New Mexico Tech, and Sandia National Laboratories at a workshop on September 2-11 in Madison, Wisconsin at the UW. Also included in the workshop was UW students, postdoctoral participants, faculty, and visitors from Tohoku University (Sendai, Japan). Charlotte Rowe of the Earth and Environmental Sciences Division was the Los Alamos participant.

The purpose of the workshop was to introduce and test new software tools for relative and absolute event relocation. “Absolute event location” improves the location estimate of seismic events by relocation using improved tools, improved models, additional data, improved data analysis methods, or some combination thereof. The workshop presented, demonstrated, and provided hands-on access to several new software tools for relative and absolute event relocation. These included a bispectrum method for validating waveform cross-correlation information, a 3D-capable modification of the "double-difference" relative relocation technique, and local (xyz), regional (spherical coordinates), and flexible grid versions of a new tomographic algorithm that incorporates both absolute and differential travel time and location data. Test applications with various datasets were performed, and software was distributed to participants. The potential for collaborative applications was discussed. These methods will be showcased in a special "location methods" session at the upcoming Fall American Geophysical Union meeting in San Francisco.

Los Alamos GISLab Wins Certificate of Award at ESRI

The Environmental Systems Research Institute (ESRI) held its Twenty-Third International User Conference in July 2003 at San Diego, California and recently released the names of the poster winners. A team entry from Los Alamos’ Earth and Environmental Sciences Geographic Information System Laboratory (GISLab) and the University of California, Santa Barbara (UCSB) were notified that they are recipients of a "Certificate of Award, Best Analytical Application, Second Place" for their poster, "Next Generation Solar Models for ArcGIS." The team of authors included Paul Rich, Los Alamos, along with colleagues Jeff Dozier, Stuart Weiss, and Joshua Metz of UCSB. The ESRI User Conference is a major meeting attended by more than 11,000 GIS professionals, and includes invited and contributed presentations, map galley/poster sessions, keynote addresses, vendor displays, and other events. "Geography and GIS˜ Serving Our World", the conference theme, honored the work of the GIS user community as they serve their respective communities. It also recognized that GIS technology provides better ways to address societal issues on a global scale. ESRI, the leading geographic information system (GIS) software company, is best known for its ArcGIS software (ArcInfo, ArcView).

The Los Alamos GISLab mission focuses on scientific and technical excellence in GIS, including leadership, basic and applied research, and GIS services for Los Alamos projects and operations. GISLab staff consistently performs at an outstanding level. In 2002, GISLab and colleagues received an ESRI Special Achievement Award for efforts during and after the Cerro Grande Fire. In 2003, the GISLab team received a Los Alamos Award Program award for their contribution to enterprise GIS.

Fehler Reports as Member of New Mexico State University Advisory Council

Dr. Michael Fehler of the Earth and Environmental Sciences Division's Geophysics Group recently reported on his activities as a member of the Advisory Council for the New Mexico State University Physics Department, which met in Las Cruces, NM the first week in September. The committee listened to several presentations regarding on going technical work in the department and matters associated with teaching and running the department. The committee met with several high-level administrators of the university, including the Dean of Research, Dean of the Faculty of Arts and Sciences, and Dean of Engineering to discuss the state of the Physics Department and the committee's recommendations regarding how to maintain or improve the department. This committee's scope and mandate are similar to the Division Review Committees at the National Laboratories who review, report, and recommend issues relating to the Science and Technology of its scientific divisions.

In contrast to last year's meeting, when the department seemed to have low morale and most everyone expressed concerns about the future of the department, morale was substantially improved this year. There are three new faculty members and a new one on the way to joining the department. The energy level in the department was very high and was a dramatic contrast to last year. The recommendations made by the committee last year were followed almost in their entirety.

Los Alamos Attends Worldwide Underground Facilities Conference

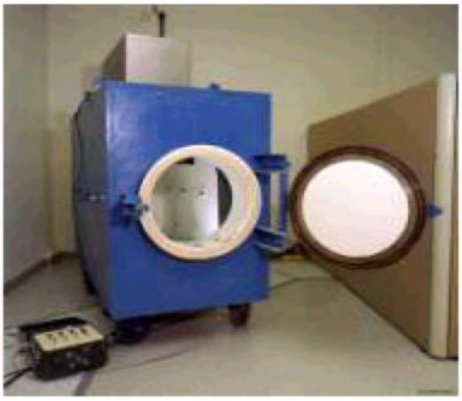
Dr. Wendee Brunish of the Earth and Environmental Sciences Division's Geophysics Group attended the Joint Worldwide Underground Facilities Conference, held at Central Intelligence Agency headquarters September 9-11. The meeting brought together experts from Defense Threat Reduction Agency, Defense Intelligence Agency, National Imagery and Mapping Agency, and a number of underground facilities around the world.

Winner of the August Mystery Image:

It was EES-2's Infrasonic Chamber!

1st Place: Craig Pearson, EES-DO
2nd Place: Terry Wallace, EES-DO

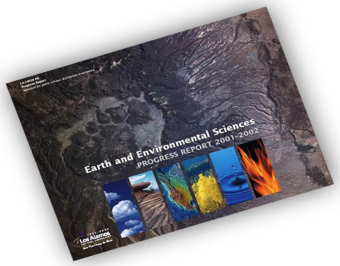
ONLY the bosses recognized this instrument??? Come on - someone else had to have recognized this ???



The open door reveals the area in the calibration chamber's interior where sensors are placed for calibration. A piston phone unit, (standard name for the calibration device for acoustics; it is piston driven) contained in the aluminum housing on top of the chamber, generates the sinusoidal calibration signal.

http://www.ees.lanl.gov/Resources/infra_collab.shtml

Read more in the Progress Report, Page 37, "Weapons Phenomenology and Infrasound."



Dottie's Mystery Image for September: What is the location of this Los Alamos wetland?

- Mortandad Canyon
- Pueblo Canyon
- Sandia Canyon

Respond to: dot@lanl.gov

EEScience

Guest Editorial

Engineered Barrier Systems (EBS) Testing Performed at the DOE North Las Vegas Test Facility

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ABSTRACT

The Yucca Mountain Project (YMP) has performed ten pilot-scale tests to evaluate various features and components of the Engineered Barrier System, such as capillary barriers, plain backfill, drip shields and ventilation systems, to manage decay heat induced thermal loads on the emplacement drifts. The data acquired from these pilot-scale tests has been used to develop and verify computer models, and to evaluate the performance of backfill configurations and drip shields. This paper describes the pilot-scale tests performed and the resulting data from the tests.

INTRODUCTION

The Yucca Mountain Project is developing currently the License Application (LA) Design for the underground repository to isolate High Level Radioactive Waste (HLW) at the proposed repository at Yucca Mountain (1). A subset of this LA design is the emplacement drifts and engineered barrier system components within them. The LA design includes alternate configurations for key subsystems that will demonstrate the ability of the LA design to accommodate unexpected conditions. In 1998, as an adjunct to the assessment for the selection of a repository design, a pilot-

scale testing program was initiated to evaluate the performance of the engineered barriers and to acquire data for either developing computer models or to validate computer models to be used for the Analysis Model Reports (AMRs) and Process Model Reports (PMRs) (2).

ENGINEERED BARRIER SYSTEM

The Engineered Barrier System (EBS) consists of emplacement drift system, the environment inside the drift, the ground support system, the waste emplacement equipment, the drip shield structure, the invert, waste packages (including spent nuclear fuel cladding), waste package support hardware, and any other performance enhancing barriers. The EBS works in concert with the natural geologic setting to retard radionuclides release into the biosphere.

ENGINEERED BARRIER SYSTEM TESTING

The EBS testing program evaluated potential enhancements such as plain (single component) backfill, capillary barriers (multiple component backfill), and drip shields, backfill over drip shield, natural convection and thermal management to prevent drip water from contacting the waste packages, thus enhancing the long-term performance of the waste packages, which could improve the long-term performance of the repository. As of now ten major tests have been performed to acquire data at the EBS Test Facility.

Tests were also performed to acquire data to assess the suitability of EBS concepts and to acquire data as input to the computer models such as ANSYS (3) (used by the YMP for the design of preclosure ventilation), and Computational Dynamics Codes such as FLUENT (4) used by the YMP for post closure and preclosure heat transfer by natural convection. EBS tests were also performed to develop computer models for flow over drip shield such as the split flow model (5). The tests achieved their objectives, and uses of the resulting data are described below.

ENGINEERED BARRIER PILOT-SCALE TEST FACILITY

The test facility is located on Losee Road in North Las Vegas. The test facility is equipped with 20-ton overhead cranes for moving and installing large test assemblies. The support facility also includes overhead rollup doors and two offices: one for test coordination and management and one for data acquisition from approximately 800 channels of instrumentation. In present configuration, the test facility also has limited capability to support geologic/hydrologic testing and preparation of test samples and components. The following test hardware is available at the facility:

- *Test assembly 40.2 m long having internal diameter of 1.37 m*
- *Test assembly 11.14 m long and having inside diameter of 1.37 m*
- *Test assembly 18.57 m long having inside diameter of 2.44 m*
- *A test chamber with drip shield 2.5 m high, 4 m wide and 4 m long*
- *Several surrogate waste packages fabricated from steel of varying scaled lengths and diameters*
- *Four steel test assemblies 4.0 m long having a inside diameter of 1.4 m*
- *Several quarter scale and 44% scale surrogate drip shields.*

EBS TESTS PERFORMED

As of now, the following ten tests have been performed at the EBS test facility. They are as follows:

1. Quarter scale capillary barrier

2. Plain backfill tests at ambient temperature

3. Quarter scale elevated temperature drip shield test

4. Quarter scale plain backfill over drip shield elevated temperature test

5. Thermal-hydraulic-chemical column test

6. Quarter scale ventilation test, Phase 1, ambient inlet air test

7. Quarter scale ventilation test, Phase 2, conditioned inlet air test

8. Forty-four percent natural convection test

9. Quarter scale natural convection test

10. Full scale breached drip shield test.

MAJOR TEST INSTRUMENTS

The major instruments used to acquire Quality Assured (QA) data were thermocouples, resistance temperature devices (RTD), relative humidity sensors, heat dissipation probes, lysimeters, fiberglass wicks, weigh scales, air velocity sensors, barometers, pitot tubes, video cameras and a neutral buoyancy helium bubble generator. The data acquired from the tests performed and utility of the data to the project are briefly described below.

APPLICATION OF THE TEST RESULTS

A Quarter Scale Backfill Tests at Ambient Temperature

Two ambient temperature backfill tests (capillary barrier based backfill and plain backfill tests) were performed in quarter scale steel cells 1.4 m in diameter and 4.0 m long. Acrylic surrogate waste package, 40 cm in diameter and 3.07 m long, was used to visualize the irrigated water as it moved through the backfill and removed by the fiberglass wicks or lysimeters (6). The tests were irrigated by drip water injected from the crown of the test cell at a rate of one liter per hour. The capillary barrier was constructed by placing fine-grained Overton sand (passing sieve #50 and retained on sieve #70) over coarse sand (passing sieve #8 and retained on sieve #20), Figure 1.

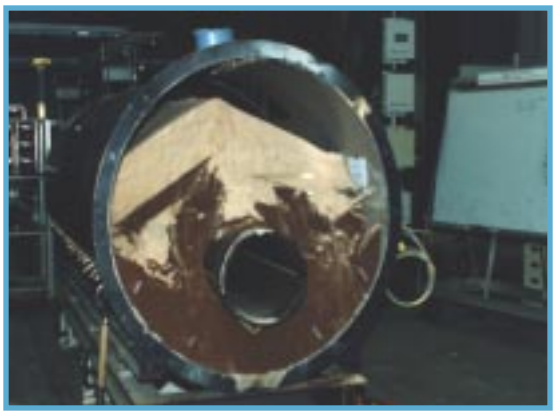

Figure 1. Quarter scale capillary barrier.

It was noted that the backfill installed as capillary barrier diverted over 90 percent of the irrigated water. The test successfully ran for one year. Post-test evaluation indicated that the coarse layer of the sand was getting moist. Liquid water however did not contact the acrylic waste package.

In the case of plain backfill test, the irrigated water contacted the acrylic waste package with in 72 hours, Figure 2.

Figure 2. Plain backfill over surrogate waste package.

The data acquired was used to help define LA design options (1).

Quarter Scale Elevated Temperature Drip Shield Test

This test was performed at elevated temperature in a quarter scale steel cell 1.4 m in diameter and 4.0 m long. A carbon steel surrogate waste package having a diameter of 39 cm and length of 3.88 m was used to simulate a quarter scale Pressurized Water Reactor (PWR) surrogate waste package. A 5 kW rod heater heated the waste package. The waste package temperature was maintained at 80 degrees C (7). The inside temperature of test cell boundary wall was maintained at 60 degrees C. The boundary wall temperature was controlled by installing a film heater on the outside wall of the test cell and insulating it with fiberglass insulation. The test cell was irrigated at a rate of one liter per hour per meter test cell length.

The drip shield temperature varied between 67-73 degrees C prior to irrigation. The drip shield temperature during irrigation was 65 degrees C. No drip or condensation was observed under the drip shield. The relative humidity above the drip shield stayed at approximately 85 percent and the relative humidity under the drip shield was 65 percent.

At no time was the drip shield temperature equal to the dew point. Data acquired from this test was used by the License Application Design Selection to define design options (1) and for the FY01 Supplemental Science and Performance Analysis Volume 1 (8).

Elevated Temperature with Plain Backfill over the Drip Shield Test

This test was performed to evaluate the performance of the drip shield when covered with backfill. Plain backfill was installed over the drip shield by placing coarse sand having a particle size-passing sieve #8 and retained on sieve #20 (7). In this test the irrigated water contacted the surface of the drip shield within 72 hours. Condensate was observed at the inside crown of the test cell. This was caused by hot air rising above the backfill, which was at 65 degrees C to the crown, which was at 60 degrees C. No condensation was observed below the drip shield.

Data acquired from this test was used by the License Application Design Selection to help define repository design options.

Thermal-hydrologic-chemical Column Test

This test was performed to characterize the Thermal-Hydrologic-Chemical (THC) process that could affect behavior of crushed welded tuff that may be used as backfill or ballast in the emplacement drifts. (9). A key objective of this test was to evaluate changes in the material characteristics induced by hot refluxing water through the column (invert) such as permeability, mineral composition of the invert and chemical separation of salts and minerals.

The test column was partially open at the top and closed at the bottom. The column had a diameter of 14.6 cm.

The fill column height was 93.6 cm. The Column was filled with quarter inch mean particle size crushed Topopah Spring tuff from Yucca Mountain. Bottom 8.0 cm of the column was kept saturated by maintaining a constant head water supply. The test column was constructed from Teflon coated stainless steel.

It was observed that once the column reached steady operating conditions the entire “fill” in the column was at the boiling temperature of water. The closed loop system provided significant reflux of the condensate through the

crushed tuff. The fluid chemistry was strongly alkaline, a final pH of 10.3 was observed. The solution composition from the saturated portion at the bottom of the column was saturated or unsaturated with silica minerals, chalcedony and quartz. Secondary mineralization over 2,100 hours of operation was estimated at 70 to 100 grams.

The test results characterized process occurring in heated water system interacting with crushed tuff to model quantitatively such processes.

Quarter Scale Ventilation Test, Phase 1, Ambient Air Inlet Test

This test was performed to acquire data to evaluate the cooling affects from the ventilation air used to ventilate the emplacement drifts during the preclosure phase of the repository. Data acquired by this was also to predict the performance of the test using ANSYS (3) computer model. This computer model is used for the design of the repository ventilation system (10).

The test was performed by constructing a test cell with a 1.4 m inside diameter and a length of 40.2 m, Figure 3. This was accomplished by connecting eleven sections, each, 3.66 m long concrete culvert pipe segments with inside diameter of 1.4 m.

Figure 3. Quarter scale ventilation test setup for Phase 1 and Phase 2 tests.

Twenty-five surrogate quarter scale 21- PWR waste packages with diameter of 40.64 cm and length of 1.32 m were constructed from carbon steel. A single 5 kW heater was used to simulate the decay heat from the waste package.

Two fans were used to supply air for ventilating the test assembly. The inlet air volume was supplied by the inlet fans controlled by process controllers to couple the fan revolution and the air volume required for the test. The tests were performed at a linear thermal load of 0.18 kW/m and at 0.36 kW/m. Three inlet air volumes, 0.5, 1.0, 2.0 and 3.0 cubic meter per second were used for each of the two power settings.

Primary instrumentation consisted of: air velocity meters, air mass flow meters, pitot tubes, resistance temperature devices, power monitors, a mobile temperature and air velocity probes, pressure gauges, relative humidity sensors, barometric pressure sensors, and heat dissipation probes.

It was difficult to maintain a good control on the air inlet temperature because of diurnal temperature fluctuations. The intake air temperature fluctuated between 22 degrees C and 32 degrees C.

The measured waste package temperatures and those predicted using the ANSYS (3) computer model were found to be in fair agreement. The test provided sufficient information to conclude that the performance of the ventilation can be assessed as long as the convection heat transfer coefficient is correctly estimated.

Acquired data was used to compare the test results with those computed using ANSYS computer model. The test results are being

used for the design of the preclosure repository ventilation system (11).

Quarter Scale Ventilation Test, Phase 2, Conditioned Inlet Air Test

This test had two primary objectives. First, to provide information that will support the design of the ventilation system for the proposed repository, such that the temperature within the emplacement drifts will be maintained below boiling temperature of water. The data acquired from this phase of the test included temperature, pressure, relative humidity of the ventilation and atmospheric air, air velocity, air pressure at the inlet and the outlet of the test assembly, temperature of various components inside and outside of the test cell and the heat generated by the simulated waste packages.

The test assembly used for the first Phase of the test was also used for this test. A 10-ton heat pump was installed in return air circuit with dampers to control the inlet air temperature and relative humidity, Figure 4. The test instrumentation was the same as described above for the Phase 1 portion of the ventilation test.

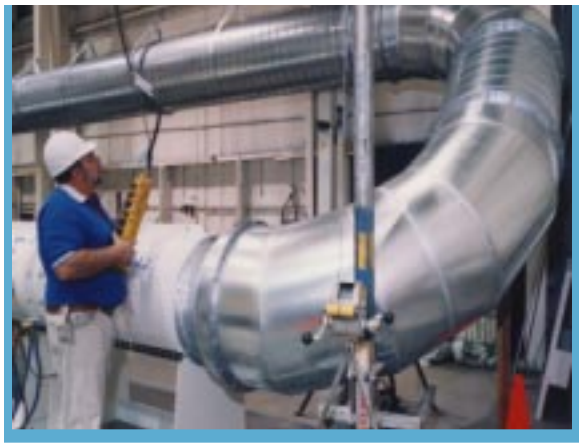

Figure 4. Air circulation system for ventilation test.

The test was performed at linear power loading of 0.22 kW/m length and 0.36-kW/m length of the test assembly for intake air volume of 0.5 and 1.0 cubic meter per second (12). The inlet air temperature was maintained between 25 and 45 degrees C. The relative humidity of the inlet air was between 10 and 50 percent. Sixteen individual test runs were performed for this phase of the test.

It was observed that the air and the test assembly temperatures increased continuously to Station 5, which is the second to last station from the end of the heated region. It was also noted that the surrogate waste package temperatures increased to the center of the test assembly and then decreased to the exit end. At any given location the surrogate waste package was the hottest followed by the concrete pipe wall followed by the ventilating air.

The preliminary review of the acquired data indicates that the ventilation efficiencies ranged from 80-90 percent. The ventilation efficiency is defined as the percentage of heat removed from the waste packages by the ventilating air. The efficiencies showed strongest correlation with inlet air temperature, decreasing as the inlet air temperature increased. Ventilation efficiencies decreased as power input increases and increases with ventilating airflow rate. The relative humidity did not affect the calculated efficiency.

Data collected was also used to compare the test results with those predicted for this test by ANSYS (3) computer model. This information is being used to predict the ability to maintain the repository to below boiling point of water.

Forty-four Percent Scale and Quarter Scale Natural Convection Tests

These tests were performed to acquire data to evaluate three dimensional effects of distrib-

uted thermal load within a scaled drift environment under post closure non ventilated conditions and to assess the contribution of convection in transferring heat from the waste packages to the boundary walls. Tests were performed at two scales to investigate the effect of scaling on heat transfer coefficients. Approximately half scale test was performed in an 18.57 m long, 2.44 m inside diameter, concrete pipe. The quarter scale test was performed in an 11.14 m long, 1.37 m inside diameter, concrete pipe (13), Figure 5.

Figure 5. Installing 44 percent Natural Convection Test.

The test cases for uniform thermal loading consisted of 2-44 Boiling Water reactor, 2-21 Pressurized Water Reactor, 1-Defense High Level Waste-Long, and 1-Defense High Level Waste-Short and one generic (either 21-Pressurized Water Reactor or 44-Boiling Water Reactor) waste packages. The test cases for distributed thermal loading consisted of 2-44 Boiling Water reactor, 2-21 Pressurized Water Reactor, 1-Defense High Level Waste-Long, and 1-Defense High Level Waste-Short waste packages. The heaters were fabricated by wrapping a heater wire on a carbon steel cell and inserting it inside another carbon steel pipe. The annulus was filled with fiberglass insulation. These heaters provide much better heat transfer than the single rod heaters. Scaled drip shields were fabricated from 316 stainless steel and installed over the waste packages. The joints between the drip shields were taped to control heat transfer from the drip shield joints. The invert was constructed from crushed welded tuff. All surrogate waste packages, pallets, and drip shields were painted with gray paint for consistent thermal emissivity.

Test instrumentation consists of 280 to 320 thermocouples and relative temperature/humidity probes were used to collect data. Visual observations of the convection currents were accomplished by injecting neutrally buoyant helium bubbles released into the test assembly and observing them with a camera. Convection current velocities were measured using Omni-directional hot-wire anemometer. Heater power was monitored by wattmeters. The data was acquired using a personal computer based data collection system.

The quarter scale test provides a clear visual of the movement of the convection currents. The convection currents were difficult to quantify in the approximately half scale test. The convection currents were less pronounced in tests with drip shields. Two general patterns were evident: 1) Convection cells existed adjacent and perpendicular to the axis of the heated waste packages rising over the center of the waste packages then turning towards the top of the cells, then following the wall back down toward the invert and 2) In the non-uniform heating test cases, the convection currents were observed rising over the heated waste packages, then turning to move more horizontal towards the top of the cell axially aligned with the convection cell, swooping down over the cool waste packages or cooler section of the invert, and back toward the heated waste packages.

The data obtained from these tests is used for the validation of the convection model imple-

mented with FLUENT (4) computational fluid dynamic code, version 6.0.12. The data will be also used by ANSYS (3) computer code as applicable.

Full Scale Breached Drip Shield Test

This test acquired data to develop a computer model to determine the probability of a seepage flux originating from a point on the emplacement drift crown, above the drip shield/waste package, to enter a single or multiple breaches. This would be used as a predictive tool to assess the transport of radioactive material from the breached waste package to the invert.

An environmentally controlled (relative humidity and temperature) chamber was used for this test. The test chamber was 4 m wide, 4 m long and 2.5 m high (14), Figure 6. A pipe at the crown was used to locate drip height equivalent to the drip from the crown of the emplacement drifts. Drip locations other than those from the crown were accomplished by moving drip nozzle location. The drip pattern was also adjusted by moving the nozzle along the longitudinal axis of the drip shield.

Figure 6. Breached waste package/drip phase II shield test.

The drip shield was 2.521 m high, 2.51 m wide with a radius of curvature 1.3 m. The invert depth was 0.806 m and the drip distance from the crown was 2.173 m. Multiple breaches with breach area of 0.072 m2 or 0.269 x 0.269 m (consistent with general corrosion patches used by the Total System Performance Assessment (14)) were created in the drip shield by cutting the metal out from the drip shield structure. The drip water was metered and collected by swabbing and collecting in gutters.

This test did not require complex instruments. Instruments used were a water flow meter, barometric pressure sensors, relative humidity and temperature sensors, and precision weigh scales. An air conditioner and three humidifiers were used to maintain high humidity within the test chamber.

SUMMARY

The data collected from the EBS testing program since its inception in 1998 has contributed in evaluating the suitability of engineered features and components to enhance the performance of the proposed repository. The data acquired from the EBS tests have been used for verification computer models such as ANSYS (3) and FLUENT (4) and has provided input for preparing the Total System Performance Assessment for Recommendation (15).

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